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RESEARCH MEMORANDUM

PAY AND RETENTION OF MARINE CORPS AVIATORS

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Encl: (1) CRM 85-21, "Pay and Retention of Marine Corps Aviators," February 1985

1. Enclosure (1) is forwarded as a matter of possible interest.

2. This Research Memorandum describes our analysis of the effect of pay and economic conditions on the retention of Marine Corps aviators. The results of the analysis are then used to evaluate the impact of changes in the structure of Aviation Career Incentive Pay.

3. The enclosure draws together and amplifies several quick response analyses we have conducted on aviator pay for the Manpower Plans and Policy Division of Headquarters, Marine Corps.

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ABSTRACT

This report studies the effect of pay on the retention of Marine Corps aviators. The estimated pay effects are then used to evaluate the potential impact of three recent proposals to adjust the structure of Aviation Career Incentive Pay (ACIP).

EXECUTIVE SUMMARY

This report investigates the effect of pay on the retention of Marine Corps aviators. It uses a simplified version of the annualized cost of leaving (ACOL) model to estimate the impact of pay changes on the voluntary attrition of Marine aviators. The estimated pay effects are then used to evaluate the potential effect of three recent proposals to adjust the structure of Aviation Career Incentive Pay (ACIP).

The analysis found that pay does have a significant effect on aviator retention. The estimated elasticity of attrition with respect to the pay differential is −0.26. (The elasticity gives the percentage change in attrition for a 1-percent change in pay.[1])

The three proposed changes to ACIP evaluated by CNA would eliminate ACIP for officers with over 25 years of service (YOS), 20 YOS, or 12 YOS. Table I shows the associated costs and benefits of each alternative. The benefits are the reduced ACIP payments, and the cost is the expense of training replacement pilots for those who will leave the military because of the pay change. The estimates show that each proposal will actually increase total expenditures once the replacement training costs are included.

The aviator's decision to stay in the Marine Corps is analyzed as an occupational choice, in which an individual chooses among a set of career opportunities, selecting the career that maximizes discounted lifetime earnings. For this study of aviators, the value of continuing in a military career is compared to the potential earnings of civilian airline pilots. Data from the military pay tables and on the average salaries of civilian airline pilots are used to calculate the expected present value of earnings over different lengths of time. As the difference between the two present values varies over time, the propensity to leave the military will also differ. The estimated pay effects are based on these variations in the relative financial gains, as well as differences in the underlying propensity to leave among different pay grades. The model is applied to data on captains and majors with

1. This elasticity is calculated at the mean of the pay variable used in the analysis, which is the difference between military and civilian pay. Other authors prefer to calculate the elasticity at the mean of military pay; in that case, the elasticity is −2.25.

6 to 14 YOS from 1973 through 1982; separate estimates are obtained for pilots and naval flight officers (NFOs).

TABLE I

ANNUAL COSTS AND BENEFITS OF ACIP PROPOSALS
(Millions of FY 1983 dollars)

	No ACIP after 12 years service	No ACIP after 20 years service	No ACIP after 25 years service
Savings from pay reduction	7.0	1.0	0.1
Cost of additional training	19.6	5.1	4.3
Net increase in total expenditures	12.6	4.1	4.2

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INTRODUCTION

Military aviators have received extra pay for almost as long as they have been flying. The traditional purposes of the additional pay is to give personnel an incentive to enter the aviation field and to compensate them for the extra risk involved. In recent years, an additional reason for increasing the pay of aviators is to entice them to remain in the military after their minimum service requirement (MSR) expires. Without a pay premium, too many military pilots will leave the service. The goal of this study is to examine the effect of pay on pilot retention and evaluate the potential impact of several proposed changes in the career pay structure of Marine aviators.

In its attempt to attain the desired accession and retention of military aviators, Congress periodically reviews and adjusts the special pay for fliers. The most recent major change occurred in 1974, when hazardous-duty flying pay was replaced by Aviation Career Incentive Pay (ACIP). ACIP gives aviators extra continuous income throughout their military careers, even though they may not always be in flying billets. Pilots qualify for continual ACIP payments by meeting minimum flight-time requirements during particular stages in their careers. In the Marine Corps, virtually all aviators satisfy the requirements, so that ACIP is, for all practical purposes, an increase in the base pay of aviation officers. In recent years, an additional Aviation Officer Continuation Pay (AOCP) bonus was granted to officers signing up for additional years of military service.

DETERMINING WHY PEOPLE STAY

In this study it is assumed that an aviator's decision about whether to stay in the Marine Corps depends primarily on the financial gains involved and the officer's preference, or taste, for military life. Although other factors enter into the decision, these two considerations are likely to be the most important.

The financial return to remaining in the military is a function of the expected income of officers and their civilian opportunities. Prospective military earnings are observed through the basic pay and allowance tables, including special and incentive pay. Civilian opportunity depends on what an officer could expect to earn after leaving the military, and the likelihood that he could find a suitable job. Unfortunately, there is a paucity of information on what officers do when they leave the military, although data on enlisted separatees are available. Most importantly, there is little known about what types of jobs are taken or what incomes are received. Because this study concentrates on aviators, the incomes of commercial pilots are used to estimate the financial opportunities available in civilian life. Pay is not the only relevant index of opportunity; changes in pilot hiring by the major airlines serve as a guide for estimating the probability of getting a job as a commercial pilot.

Obviously, not all military aviators become civilian pilots when they leave the service. Nonetheless, civilian pilot salaries should be a good indicator of an officer's potential civilian earnings. Moreover, it is likely that the chance of becoming a commercial pilot entices some to leave the military, even if they do not eventually work as pilots. Previous CNA research[1] found pilot pay and changes in airline employment significant factors in retaining Navy pilots.

EFFECTS OF CHANGING ACIP

Attrition data on Marine Corps aviators with 6 to 14 years of commissioned service for the fiscal years 1973 through 1982 were obtained from the Defense Manpower Data Center. These data were combined with information on military and civilian pay, airline hiring, and the civilian unemployment rate. Appendix A shows that, under certain assumptions, the aviator attrition rate L is related to those explanatory variables by the formula

$$ln(L/1-L) = a_0 + a_1 ACOL + a_2 \Delta Pilots + a_3 D_7 + a_4 D_8 + \ldots + a_{10} D_{14} , \qquad (1)$$

where annualized cost of leaving (ACOL) is the discounted difference between military and civilian pay, Δ Pilots is the change in the number of pilots employed by civilian airlines, and D_7, D_8, ..., D_{14} are dummy variables for aviators with 7, 8, ..., 14 years of service. Statistical regression is then used to obtain estimates of the coefficients in equation 1. Results of the analysis, which are described in detail in appendix A, indicate that pay and economic conditions have a significant effect on the attrition of Marine aviators.

The estimates of pay effects derived in appendix A can be used to predict the change in attrition that would result from altering military pay. The three

1. CNA, Study 1133, "Navy Pilot Attrition: Determinants and Economic Remedies," by Samuel D. Kleinman and Charles Zuhoski, Feb 1980.

recent congressional proposals to alter the structure of aviator pay are:

- Eliminate ACIP for officers with more than 12 years of service
- Eliminate ACIP for officers with more than 20 years of service
- Eliminate ACIP for officers with more than 25 years of service.

The proposals are evaluated in two steps. First, the increase in losses is predicted by using the estimated pay effects. Then the net cost of each proposal is calculated by subtracting the reduced ACIP pay savings from the change in pilot training costs.

Changes in loss rates are related to changes in pay by the formula[1]

$$\Delta L = a_1 L(1-L)\,\Delta ACOL \;, \tag{2}$$

where a_1 is the ACOL regression coefficient from table A-1, L is the base loss rate, and ΔACOL is the change in ACOL due to a pay change. Two rates are used because the predictions are sensitive to the choice of base loss rate. The first is the predicted increase in the loss rate that would have occurred in 1983 if the proposals were in effect; 1983 loss rates are used as the base. For an alternate prediction, estimates are made of the long-run change in pilot losses by using average loss rates for 1975 through 1982. This prediction will be more accurate because it eliminates the effect of temporarily high retention in 1983 due to the aftereffect of the AOCP and poor employment prospects in the airline industry. In the following calculations, the coefficients from column 2 in table A-1 are used; the results would be influenced only marginally if the other estimates were used instead.

The estimated increase in annual pilot attrition is calculated from table 1. The increase in the attrition rate is given by equation 2. To get the change in losses, multiply the rate change by the appropriate endstrength,

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1. Equation 2 was obtained by differentiating equation 1 with respect to ACOL.

giving

$$\Delta Attrition = a_1 L(1-L) \times (\Delta ACOL) \times (Endstrength) \; . \qquad (3)$$

For example, the increase in attrition for eliminating ACIP after 12 years' service is calculated in table 1 by

$$(Col\,3) \times (Col\,4) \times (Col\,7) \times (1 - Col\,7) \times (Col\,9) \; .$$

The results of these calculations are summarized in tables 2 and 3. Although the choice of base loss rate has some effect, the estimates are similar and move together. Each proposed change has an impact that varies in severity depending in which YOS the ACIP reduction begins.

TABLE 1

RETENTION EFFECTS OF ACIP PROPOSALS

			Reductions in ACOL ($ thousands) when no ACIP after:			Retention rates		
Rank	YOS	Pay effect	12 YOS	20 YOS	25 YOS	1975-1983	1983	1983 endstrength
0-3	6	0.052	2.268	0.573	0.392	0.673	0.695	282
0-3	7	0.052	2.524	0.637	0.436	0.781	0.795	331
0-3	8	0.052	2.811	0.710	0.486	0.858	0.887	274
0-3	9	0.052	3.136	0.792	0.542	0.877	0.948	173
0-3	10	0.052	3.504	0.885	0.606	0.899	0.952	230
0-4	11	0.052	3.923	0.991	0.678	0.907	0.976	82
0-4	12	0.052	4.402	1.112	0.761	0.914	0.969	160
0-4	13	0.052	4.352	1.250	0.855	0.931	1.000	128
0-4	14	0.052	4.295	1.410	0.965	0.947	0.988	173

TABLE 2

INCREASED PILOT LOSSES FOR 1983[a]

	No ACIP over 12 YOS	No ACIP over 20 YOS	No ACIP over 25 YOS
Captains (6-10 YOS)	21[b]	5	4
Majors (11-14 YOS)	2	1	0

a. These estimates are the predicted number of additional pilots that would have left the Marine Corps in 1983 if the proposals had been in effect.

b. The increase in pilot losses is calculated in table 1 by the formula: (Col 3) × (Col 8) × (1 – Col 8) × (Col 9) × (change in ACOL, Cols 4, 5, 6).

TABLE 3

LONG-RUN INCREASE IN PILOT LOSSES PER YEAR[a]

	No ACIP over 12 YOS	No ACIP over 20 YOS	No ACIP over 25 YOS
Captains (6-10 YOS)	26[b]	7	5
Majors (11-14 YOS)	8	2	2

a. These estimates represent the increase in pilot attrition per year using average retention rates for 1975 through 1983.

b. Same as b above except Col 8 is changed to Col 7.

Before the desirability of these proposals can be decided, the total costs and benefits must be estimated. The primary cost savings are simply the reduced ACIP payments to military personnel. The indirect cost of reducing ACIP is the expense of training replacements for the pilots who left because of the pay change. The cost of training a Marine aviator is about $850,000, so the loss of only a few fliers would be enough to offset any potential cost savings.

To estimate the increase in aviator accessions, it is assumed that the number of aviators with 1 to 14 YOS will be maintained at the 1983 level of 4,150. The formula that equates desired endstrength with required accessions is

$$ES = A(\Sigma R_i) , \tag{4}$$

where ES is endstrength, A is accessions, and R_i is the probability of staying until year i. This implies

$$\frac{\Delta ES}{ES} = \frac{\Delta(\Sigma R_i)}{\Sigma R_i} + \frac{\Delta A}{A} , \tag{5}$$

where Δ means a change in the variable. If endstrength is to be constant, the percentage changes in retention and accessions must exactly offset each other. Given information on retention and desired endstrength, the formula also states the number of accessions needed to maintain the required force size.

Using average retention rates from 1975 through 1983, ΣR_i is estimated to be 6.61. Equation 4 indicates that 4,150/6.61 = 628 accessions per year are required to keep endstrength at 4,150. Using the information supplied in table 1, retention was recalculated for each of the ACIP proposals and is listed in table 4. The results of these calculations show that an additional 23 accessions per year will be required if ACIP is eliminated over 12 years. Eliminating ACIP over 20 years and 25 years raises accession requirements by 6 and 5, respectively.

TABLE 4

CALCULATION OF RETENTION RATES[a]

YOS	1975-1983 C_i	1975-1983 R_i	No ACIP after 12 YOS C_i	No ACIP after 20 YOS C_i	No ACIP after 25 YOS C_i
1	0.955	0.955	0.955	0.955	0.955
2	0.936	0.894	0.936	0.936	0.936
3	0.983	0.879	0.983	0.983	0.983
4	0.948	0.833	0.948	0.948	0.948
5	0.804	0.670	0.804	0.804	0.804
6	0.673	0.451	0.647	0.666	0.669
7	0.781	0.352	0.759	0.775	0.777
8	0.858	0.302	0.840	0.854	0.855
9	0.877	0.265	0.859	0.873	0.874
10	0.899	0.238	0.882	0.895	0.896
11	0.907	0.216	0.890	0.903	0.904
12	0.914	0.197	0.896	0.909	0.911
13	0.931	0.184	0.916	0.927	0.928
14	0.947	0.174	0.936	0.943	0.944
		$\Sigma R_i = 6.609$	$\Sigma R_i = 6.365$	$\Sigma R_i = 6.544$	$\Sigma R_i = 6.556$

C_i = Probability of continuing from YOS_i to YOS_{i+1}

R_i = Probability of completing YOS_i

$R_i = R_{i-1} \times C_i = C_1 \times C_2 \times \ldots \times C_i$

a. Continuation rates for YOS 1 to 5 are assumed to be unaffected by the ACIP proposals.

Table 5 lists the costs and benefits of the three ACIP proposals. The training costs are based on a per-capita cost of $850,000. The estimated reductions in ACIP payments are based on Marine Corps projections for the number of aviators scheduled to receive ACIP in fiscal 1984. In each case, reducing ACIP to Marine aviators actually increases total costs when the expense of replacement training is included.

TABLE 5

ANNUAL COSTS AND BENEFITS OF ACIP PROPOSALS
(Millions of FY 1983 dollars)

	No ACIP over 12 years	No ACIP over 20 years	No ACIP over 25 years
Pay reduction	7.0	1.0	0.1
Increase in training costs	19.6	5.1	4.3
Net increase in total expenditures	12.6	4.1	4.2

Although the results of this analysis should be considered tentative because of limitations of the data, they do show that the current ACIP program effectively reduces total manpower costs for Marine Corps pilots.

Several changes in this study would improve the accuracy of the estimates of pay effects. The most important improvement would gather more precise information on the post-military earnings potential of Marine Corps officers. The civilian pilot salaries used in this study, while plausible, apply to an unknown fraction of separatees. An ideal match would be between an individual's military occupational field and civilian opportunities. Better estimates of the effects of military and civilian experience on pay would be useful, too.

More exact retention data would also improve the analysis substantially. The main problem with the attrition rates used here is that nothing is known about the individuals studied, such as whether they have satisfied their MSR. Information on other personal characteristics (education, marital status) would also be helpful.

APPENDIX A

A MODEL OF RETENTION BEHAVIOR

APPENDIX A

A MODEL OF RETENTION BEHAVIOR

To estimate the responsiveness of Marine pilots to pay changes, a version of the annualized cost of leaving (ACOL) model, developed earlier at CNA and applied frequently in manpower analysis,[1] is used. This model analyzes the decision to choose a lifetime military career. Using this model, an officer compares the costs and benefits of remaining in the military over an extended period of time with the costs and benefits of work as a civilian, and bases his decision on the relative merits of staying or leaving. This approach makes it possible to analyze the effects of pay changes far into the future, such as changes in the military retirement system. This study will evaluate the impact of several proposals for changing the current ACIP structure. For example, one proposal is to eliminate ACIP for officers with more than 12 years of service. This pay decrease will affect the retention not only of those directly affected, but also officers with just 5 or 6 years of service, because their expected military career earnings will be reduced significantly.

To analyze the problem, military and civilian incomes are compared over a given time. Because the profession includes significant nonpecuniary benefits and costs, a "taste" for military service is also used as one of the determining factors. The taste factor, denoted by δ, represents the monetary value of the nonfinancial aspects of military versus civilian life and is, of course, not directly observable. An individual's preference for the military presumably is fixed for each person, but will vary throughout the population.

For simplicity, it is assumed that the comparable value of future military and civilian income will remain unchanged. Furthermore, the decision to stay in the service is based solely on information currently available and on the assumption that additional learning about future career opportunities will not occur. Although these assumptions are somewhat unrealistic, they must be made in order to structure the problem so that a clear-cut decision can be made.

1. CNA, Research Contribution 376, "Alternative Military Retirement Decisions: Their Effects on Enlisted Retention," by John T. Warner, Sep 1979.

Denote M_i as real military income[1] where $i = 1, ..., N$ represents additional years of military service and N is the time the officer leaves the Marine Corps. Similarly, let C_{iN} be the civilian salary for an individual who leaves the military with N years of service. R_N is the retired pay for an officer who retires after N more years of service. An individual's taste for military life is represented by δ. Then the total financial gain for remaining in the military for N more years of military service is

$$\sum_{i=0}^{N} d^i(M_i + \delta) + \sum_{i=N+1}^{T} d^i R_N \ ,$$

where d, the discount factor, equals1/1 + r, r is the personal discount rate, and T is the time horizon. The benefit of becoming a civilian after N more years in the military is

$$\sum_{i=N+1}^{T} d^i C_{iN} \ .$$

An officer will remain in the military if the total return from staying in the service for a period of time is greater than what he would get as a civilian.The officer will choose to remain for N more years if

$$\sum_{i=0}^{N} d^i(M_i + \delta) + \sum_{i=N+1}^{T} d^i R_N + \sum_{i=N+1}^{T} d^i C_{iN} > \sum_{i=0}^{T} d^i C_{i0} + \sum_{i=0}^{T} d^i R_0 \ . \tag{A-1}$$

The left-hand side of equation A-1 gives the present value of earnings for remaining for N more years and has three components. The first term on the left-hand side is the present value of military pay and the taste factor for N years.The next term gives the present value of retired pay if he retires N years from now, and the third sum is the value of civilian earnings after leaving the military. The sum of these three components is compared to the

1. Military income is Regular Military Compensation (RMC) plus ACIP and a continuation bonus, if any. RMC consists of base pay, allowances for quarters and support, and an imputed tax advantage.

two sources of income if the officer were to enter civilian life immediately: civilian earnings and retired pay (which will be zero if fewer than 20 YOS have been accumulated).

The relationship in equation A-1 can be calculated for all possible values of N. Which values of N are relevant to the decision-making process? Theoretically, the individual should compare the two sides of equation A-1 for all possible values of N. If equation A-1 holds for any particular value of N, the officer should remain in the military. The individual will leave if no N satisfies the requirement. For purposes of estimation, the correct N to use is the one maximizing the difference between military and civilian income. This would indicate whether an individual will remain in the military for another year, which will happen only if the maximum pay differential is positive.

Computing the values of all variables in equation A-1 for all values of N can be burdensome. An added complication is the lack of good data on the post-retirement opportunities of military personnel. These problems are handled by restricting the set of opportunities to a few specific times and excluding post-retirement civilian earnings from the calculations. Given the structure of the military retirement system and the military-civilian earnings growth differential, it is generally best for an officer to remain at least 20 YOS, if he stays at all. It is at the 20-year point that concrete information about civilian opportunities becomes sketchy, so three different time periods, determined by the date the officer would retire, were examined. The three cases studied were retirement at 20, 25, and 30 YOS. Because the YOS had little effect on the analysis, only the results using the 30-year time span are reported.

The results indicate that a decision to stay in the military is made by simply comparing current military and civilian income opportunities. Because uncertainty about the future or learning about potential earnings are not considered, the decision is essentially myopic. That is, it only depends on the difference in present value of military and civilian earnings at the time a decision is reached. (For this analysis, a stay-leave decision is made only once a year.)

With these simplifications, the basic requirement for leaving the military can be expressed as

$$\sum_{i=0}^{N} d^i C_i > \sum_{i=0}^{N} d^i (M_i + \delta) + \sum_{i=N+1}^{T} d^i R_N , \tag{A-2}$$

Individuals who prefer military life ($\delta > 0$) are willing to forego higher earnings in the civilian sector to remain in the Marine Corps. Conversely, people with a negative taste for the military must be paid a premium over their potential civilian salaries to keep them in the service.

Equation A-2 can be rewritten to express this idea more directly.

$$-\delta > \frac{\sum_{i=0}^{N} d^i (M_i - C_i) + \sum_{i=N+1}^{T} d^i R_N}{\sum_{i=0}^{N} d^i} \tag{A-3}$$

The right-hand side of the equation is the annualized cost of leaving (ACOL). If the present values of military and civilian pay (including retired pay) were equal, equation A-3 states that only individuals with a positive taste for military service will stay in the Marine Corps. If the military pay is greater, the service will attract people with negative taste factors. Because the relative values of military and civilian earnings vary for years of service and over time, the associated attrition rates will also change.

This model makes two important predictions about attrition. First, the loss rate will decline as the years of service increase, even if there is no change in the cost of leaving. This occurs because most of those with low or negative tastes for military life will already have left. Those remaining are less likely to leave because they have a strong preference for military life.

The second prediction is that attrition rates for particular pay grades will differ from year to year as the right-hand side of equation A-3 changes. This results directly from the difference in income opportunities: If civilian pay rises but military pay does not, more officers will leave because the financial sacrifice is too great.

According to these effects, captains with 10 YOS should have lower attrition than captains with 6 YOS, but both groups should have greater losses in 1979 than in 1982 because of the higher military pay in the latter year. The data confirm both predictions.

THE DATA

To assess empirically the effects of pay on attrition requires that future incomes for military and civilian careers be estimated. In calculating expected military wages, the annual pay tables are used to derive the value of RMC for each pay grade, and ACIP and continuation bonuses, if any, are added. The data used in this analysis are provided in appendix B.

Civilian earnings were estimated from data provided by the Airline Pilots Association (ALPA). Information on average salaries by age and years of civilian experience is available for each year from 1973 through 1982. From those data, separate experience-earnings profiles for each year were calculated. Each year is analyzed separately to capture the change in the civilian pilot pay structure since the deregulation of commercial air transportation. The regression equation used was taken from the human capital literature and has the form

$$ln(Wage) = a_0 + a_1 Exp + a_2 Exp^2 + a_3 Exp^3 \ , \qquad \text{(A-4)}$$

where ln(Wage) is the natural logarithm of civilian pilot salary and EXP is the number of years of civilian flying experience. The coefficients were then used to predict expected lifetime earnings for those leaving the Marine Corps. Projected earnings for 1973 through 1975 were calculated by applying the profile estimated for 1976 and adjusting it for the increases in average annual salary from 1973 to 1976, as reported by ALPA. The discount rate used to calculate the present value of military and civilian pay is 10 percent.

Loss rates are assumed to follow a logistic distribution, in which the probability of leaving the military P is related to the explanatory variables X by

$$P(Leave) = L = \frac{1}{1 + e^{-X\beta}} , \tag{A-5}$$

where L is the attrition rate and β the coefficients corresponding to the set of independent variables X. The formula in equation A-5 is nonlinear and difficult to estimate, but by using a transformation of the odds ratio (L/1- L), a simple linear estimating equation can be derived:

$$ln(L/1 - L) = X\beta . \tag{A-6}$$

The attrition data used in the study were obtained from the Defense Manpower Data Center (DMDC) and extend from 1973 to 1982 (table B-1). Attrition rates for 1973 to 1974 were unusually high, however. Marine officers indicated that this was due primarily to the policy of reducing flying hours and increasing garrison time, making a career in the Marine Corps appear less attractive. To control for this policy, a dummy variable is included. For each year, the loss rate is calculated for every grade – YOS combination for captains with 6 to 10 YOS and majors with 11 to 14 YOS. These YOS groups were selected because they are considered the critical years for retaining officers and filling operational flying requirements. Also, officers younger and older than those studied are not likely to respond to civilian opportunities in the same way. Many of those with fewer than 6 YOS have not yet satisfied their minimum service requirement, and therefore cannot leave voluntarily. Those with more than 14 YOS have such a large stake in qualifying for retirement that they are less concerned about pay changes. For these reasons, the study focuses on servicemen with 6 to 14 YOS.

In 1981 Congress established Aviation Officer Continuation Pay, which granted a cash bonus to aviators who extended their service obligations for a specified number of years. This would tend to reduce attrition in later years because officers accepting AOCP are obligated to remain in the service for the length of their contract. However, this effect does not show up in the data used in this study because Congress did not approve funding until July 1981, too late for the program to have any effect on the attrition rates for fiscal 1982 (although it should have an influence for several years after that).

Table A-1 presents the estimates for two specifications of the equations. The first specification uses the civilian unemployment rate as a guide for civilian opportunities. The second specification replaces the unemployment rate with the change in the number of pilots employed by the major airlines. The basic equation A-6 was modified by adding dummy variables for different years of service to account for the decline in average attrition for higher YOS groups. Variables reflecting the probability of finding employment were also added. The variables used are changes in the number of pilots employed by the major airlines. Equation A-7 shows the regression equation used.

$$ln(L/1-L) = a_0 + a_1 ACOL + a_2 \Delta Pilots + a_3 D_7 + a_4 D_8 + \ldots + a_{10} D_{14} , \qquad \text{(A-7)}$$

where Δ Pilots is the change in the number of pilots employed by the airlines, and D_7, D_8, ..., D_{14}, are dummy variables for different YOS. Estimates were also obtained replacing Δ Pilots with the civilian unemployment rate, Urate.

Pay coefficients are significant for both specifications, with the elasticity of the attrition rate to the ACOL 0.20 and 0.26 for the two equations.

There is a possibility that the pay effects are biased due to the pooling of the different YOS groups. This hypothesis was tested by interacting a dummy variable for the higher grade with pay; the coefficient was insignificant.

Many Marine pilots fly helicopters. It is possible that their behavior would differ from that of pilots of fixed-wing aircraft. Table A-2 shows the results when only data on fixed-wing pilots are included. The results are not much different from those found using all aviators.

For captains with 6 to 10 YOS, attrition rates for naval flight officers (NFOs) are also available. (There are not enough NFOs in higher ranks to perform a statistical analysis.) The results in table A-3 show that these NFOs are more responsive to pay changes than pilots in the same group. Presumably, NFOs would be less sensitive to civilian pilot pay because they are not as fully trained as the pilots. However, there is no significant influence of pilot hiring or changes in unemployment on NFO attrition.

TABLE A-1

REGRESSION RESULTS FOR CAPTAINS AND MAJORS WITH 6-14 YOS (ALL AVIATORS)

	Specification (1)	Specification (2)
Constant	0.336	– 0.804
	(1.21)a	(11.11)
ACOL × 1,000	– 0.040	– 0.052
	(4.39)	(5.76)
Urate	– 0.147	–b
	(4.12)	
Pilots × 1,000	–b	0.079
		(4.29)
Dummy variables		
YOS = 7	– 0.550	– 0.539
	(5.81)	(5.74)
YOS = 8	– 1.054	– 1.014
	(9.35)	(9.12)
YOS = 9	– 1.123	– 1.058
	(8.83)	(8.47)
YOS = 10	– 1.288	– 1.203
	(8.41)	(7.99)
YOS = 11	– 1.440	– 1.337
	(4.58)	(4.29)
YOS = 12	– 1.907	– 1.804
	(7.68)	(7.38)
YOS = 13	– 2.041	– 1.936
	(7.76)	(7.45)
YOS = 14	– 2.304	– 2.144
	(6.68)	(6.28)

TABLE A-1 (Continued)

	Specification (1)	Specification (2)
FY = 73 or 74	0.481 (3.00)	0.954 (7.28)
N	90	90
R^2	0.8467	0.8482

a. Absolute value of t-statistics in parentheses.
b. Variable not included in specification.

TABLE A-2

REGRESSION RESULTS FOR PILOTS OF FIXED-WING AIRCRAFT

	Specification (1)	Specification (2)
Constant	0.796 (1.82)[a]	− 0.673 (6.00)
ACOL × 1,000	− 0.044 (3.13)	− 0.057 (4.11)
Urate	− 0.192 (3.40)	–[b]
Pilots × 1,000	–[b]	0.081 (2.86)
Dummy variables		
YOS = 7	− 0.421 (2.91)	− 0.411 (2.78)
YOS = 8	− 0.999 (5.86)	− 0.944 (5.46)
YOS = 9	− 1.007 (5.47)	− 0.907 (4.92)
YOS = 10	− 1.203 (5.37)	− 1.087 (4.84)
YOS = 11	− 1.390 (3.30)	− 1.256 (2.93)
YOS = 12	− 1.781 (5.57)	− 1.640 (5.10)
YOS = 13	− 1.677 (5.21)	− 1.569 (4.81)
YOS = 14	− 2.106 (4.72)	− 1.939 (4.27)

TABLE A-2 (Continued

	Specification (1)	Specification (2)
FY = 73 or 74	0.274 (1.16)	0.855 (4.42)
N	90	90
R^2	0.7555	0.7441

a. Absolute value of t-statistics in parentheses.
b. Variable not included in specification.

TABLE A-3

REGRESSION RESULTS FOR NAVAL FLIGHT OFFICERS

	Specification (1)	Specification (2)
Constant	− 1.177	− 1.253
	(1.84)[a]	(6.81)
ACOL × 1,000	− 0.076	− 0.081
	(3.40)	(3.75)
Urate	− 0.008	–[b]
	(0.10)	
Pilots × 1,000	–[b]	0.058
		(1.39)
Dummy variables		
YOS = 7	− 0.145	− 0.148
	(0.66)	(0.69)
YOS = 8	− 0.881	− 0.882
	(3.23)	(3.33)
YOS = 9	− 0.738	− 0.736
	(1.62)	(2.41)
YOS = 10	− 0.551	− 0.517
	(3.05)	(1.56)
FY = 73 or 74	1.307	1.384
	(3.05)	(4.01)
N	50	50
R^2	0.4405	0.4648

a. Absolute value of t-statistics in parentheses.
b. Variable not included in specification.

TABLE A-4

VARIABLE MEANS (ALL AVIATORS)

	Mean	Standard deviation
ACOL	5,816	8,256
Log(L/1 – L)	– 2.57	1.95
Δ Pilots	154	1,853
Urate	6.9	1.3
Loss rate	0.136	0.124

TABLE A-5

CORRELATION MATRIX (ALL AVIATORS)

	ACOL	Log(L/1-L)	Δ Pilots	Urate
ACOL	1.00	– 0.59	0.04	– 0.29
Log(1/1 – L)	– 0.59	1.00	0.04	– 0.09
Δ Pilots	0.04	0.04	1.00	– 0.55
Urate	– 0.29	– 0.09	– 0.55	1.00
Loss rate	– 0.57	0.72	0.15	– 0.18

APPENDIX B

DATA TABLES

TABLE B-1

ATTRITION AND PAY DATA FOR ALL AVIATORS

FISCAL YEAR	RANK	YOS	ATTRITION	END-STRENGTH	MILITARY PAY[a]	CIVILIAN PAY[a]
1973	0-3	6	163	405	447476	417000
1973	0-3	7	99	357	453652	408000
1973	0-3	8	40	213	460444	398000
1973	0-3	9	16	152	466762	388000
1973	0-3	10	8	124	473712	364000
1973	0-4	11	0	50	479596	364000
1973	0-4	12	1	87	483634	351000
1973	0-4	13	3	74	486074	336000
1973	0-4	14	1	97	488758	304000
1974	0-3	6	191	344	424129	424000
1974	0-3	7	98	300	429996	414000
1974	0-3	8	57	262	436450	405000
1974	0-3	9	33	174	442476	394000
1974	0-3	10	15	118	449102	370000
1974	0-4	11	2	30	454751	370000
1974	0-4	12	3	89	458680	357000
1974	0-4	13	4	92	461069	341000
1974	0-4	14	2	81	463697	308000
1975	0-3	6	112	350	411365	441000
1975	0-3	7	39	294	417092	431000
1975	0-3	8	27	273	423392	421000
1975	0-3	9	21	234	429290	410000
1975	0-3	10	11	139	435779	385000
1975	0-4	11	3	35	441331	385000
1975	0-4	12	3	61	445188	371000
1975	0-4	13	2	97	447578	355000
1975	0-4	14	0	91	450208	321000
1976	0-3	6	91	274	408255	445000
1976	0-3	7	45	314	414057	435000
1976	0-3	8	30	266	420440	425000
1976	0-3	9	21	255	426391	414000
1976	0-3	10	19	190	432936	388000
1976	0-4	11	3	67	438483	388000
1976	0-4	12	0	71	442318	374000
1976	0-4	13	3	73	444699	358000
1976	0-4	14	0	106	447318	323000
1977	0-3	6	109	344	404326	453000
1977	0-3	7	53	234	410167	443000
1977	0-3	8	31	298	416592	432000
1977	0-3	9	29	261	422612	420000
1977	0-3	10	22	248	429236	394000
1977	0-4	11	2	90	434883	394000
1977	0-4	12	2	87	438744	378000
1977	0-4	13	0	74	441193	362000
1977	0-4	14	1	76	443887	324000

TABLE B-1 (Continued)

FISCAL YEAR	RANK	YOS	ATTRITION	END-STRENGTH	MILITARY PAY[a]	CIVILIAN PAY[a]
1978	0-3	7	54	298	411140	461000
1978	0-3	8	46	207	417494	450000
1978	0-3	9	44	267	423459	438000
1978	0-3	10	22	251	430020	412000
1978	0-4	11	4	43	435724	412000
1978	0-4	12	6	128	439690	396000
1978	0-4	13	3	103	442219	380000
1978	0-4	14	2	75	445000	343000
1979	0-3	6	99	234	385995	481000
1979	0-3	7	73	209	391524	471000
1979	0-3	8	52	269	397606	461000
1979	0-3	9	51	196	403360	449000
1979	0-3	10	41	247	409689	423000
1979	0-4	11	6	16	415217	423000
1979	0-4	12	19	160	419023	408000
1979	0-4	13	15	157	421442	392000
1979	0-4	14	7	113	424102	356000
1980	0-3	6	92	229	363607	504000
1980	0-3	7	58	261	368868	494000
1980	0-3	8	35	177	374655	484000
1980	0-3	9	23	238	380126	472000
1980	0-3	10	20	186	386144	446000
1980	0-4	11	6	37	391390	446000
1980	0-4	12	11	155	395017	431000
1980	0-4	13	7	176	397319	415000
1980	0-4	14	7	166	399850	380000
1981	0-3	6	128	373	370839	522000
1981	0-3	7	79	217	376255	512000
1981	0-3	8	35	244	382212	502000
1981	0-3	9	34	160	387835	490000
1981	0-3	10	20	225	394022	464000
1981	0-4	11	4	63	399382	464000
1981	0-4	12	5	163	403110	449000
1981	0-4	13	5	184	405526	433000
1981	0-4	14	2	178	408182	397000
1982	0-3	6	79	323	405207	505000
1982	0-3	7	75	294	411213	495000
1982	0-3	8	20	186	417817	485000
1982	0-3	9	15	241	424055	473000
1982	0-3	10	19	149	430916	447000
1982	0-4	11	3	80	436888	447000
1982	0-4	12	4	117	441051	432000
1982	0-4	13	7	173	443755	416000
1982	0-4	14	5	186	446730	382000

a. Pay data in 1982 dollars.

TABLE B-2

NOMINAL DOLLARS

Flight and Aviation Carreer Incentive Pay

Rank	Yos	1973	1974-1980	1981	1982
O-3	6	2160	2940	3672	4800
O-3	7	2160	2940	3672	4800
O-3	8	2220	2940	3672	4800
O-3	9	2220	2940	3672	4800
O-3	10	2280	2940	3672	4800
O-4	11	2520	2940	3672	4800
O-4	12	2580	2940	3672	4800
O-4	13	2580	2940	3672	4800
O-4	14	2640	2940	3672	4800
O-4	15	2640	2940	3672	4800
O-5	16	2760	2940	3672	4800
O-5	17	2760	2940	3672	4800
O-5	18	2940	2700	3372	4440
O-5	19	2940	2700	3372	4440
O-5	20	2940	2460	3072	4080
O-5	21	2940	2460	3072	4080
O-5	22	2940	2220	2772	3720
O-6	23	2940	2220	2772	3720
O-6	24	2940	2220	2772	3720
O-6	25	2940	2220	2772	3720
O-6	26	2940	0	0	3000
O-6	27	2940	0	0	3000
O-6	28	2940	0	0	3000
O-6	29	2940	0	0	3000
O-6	30	2940	0	0	3000

TABLE B-3

PILOTS OF FIXED-WING AIRCRAFT

FISCAL YEAR	RANK	YOS	ATT	END-STRENGTH
1973	3	6	60	230
1973	3	7	51	172
1973	3	8	21	79
1973	3	9	10	67
1973	3	10	6	55
1973	4	11	0	23
1973	4	12	0	33
1973	4	13	3	26
1973	4	14	0	32
1974	3	6	105	171
1974	3	7	52	156
1974	3	8	29	125
1974	3	9	16	63
1974	3	10	6	55
1974	4	11	2	8
1974	4	12	1	42
1974	4	13	3	34
1974	4	14	0	31
1975	3	6	71	175
1975	3	7	21	124
1975	3	8	9	130
1975	3	9	10	107
1975	3	10	5	50
1975	4	11	1	17
1975	4	12	1	20
1975	4	13	0	49
1975	4	14	0	37
1976	3	6	50	121
1976	3	7	26	152
1976	3	8	17	103
1976	3	9	15	113
1976	3	10	12	92
1976	4	11	3	27
1976	4	12	0	29
1976	4	13	3	26
1976	4	14	0	51
1977	3	6	45	210
1977	3	7	24	98
1977	3	8	19	127
1977	3	9	22	93
1977	3	10	17	107
1977	4	11	1	38
1977	4	12	2	31
1977	4	13	0	31
1977	4	14	0	24

TABLE B-3 (Continued)

FISCAL YEAR	RANK	YOS	ATT	END-STRENGTH
1978	3	6	37	116
1978	3	7	32	192
1978	3	8	22	85
1978	3	9	30	103
1978	3	10	17	85
1978	4	11	2	21
1978	4	12	5	53
1978	4	13	1	41
1978	4	14	0	31
1979	3	6	31	118
1979	3	7	31	107
1979	3	8	29	175
1979	3	9	21	83
1979	3	10	23	94
1979	4	11	3	4
1979	4	12	13	66
1979	4	13	12	64
1979	4	14	0	46
1980	3	6	30	124
1980	3	7	19	149
1980	3	8	11	90
1980	3	9	14	152
1980	3	10	5	83
1980	4	11	4	15
1980	4	12	6	55
1980	4	13	3	73
1980	4	14	0	72
1981	3	6	30	197
1981	3	7	30	118
1981	3	8	11	144
1981	3	9	13	82
1981	3	10	5	146
1981	4	11	2	19
1981	4	12	4	61
1981	4	13	5	61
1981	4	14	0	79
1982	3	6	19	186
1982	3	7	26	146
1982	3	8	5	95
1982	3	9	1	137
1982	3	10	8	81
1982	4	11	0	49
1982	4	12	2	49
1982	4	13	6	66
1982	4	14	0	63

TABLE B-4

NAVAL FLIGHT OFFICERS

FISCAL YEAR	YOS	ATT	END-STRENGTH
1973	6	11	28
1973	7	11	29
1973	8	5	21
1973	9	1	12
1973	10	1	14
1974	6	6	35
1974	7	7	25
1974	8	3	25
1974	9	5	20
1974	10	6	9
1975	6	10	36
1975	7	2	34
1975	8	2	23
1975	9	2	21
1975	10	0	16
1976	6	4	33
1976	7	4	38
1976	8	2	34
1976	9	2	23
1976	10	1	18
1977	6	5	43
1977	7	5	26
1977	8	3	38
1977	9	0	33
1977	10	1	24
1978	6	4	25
1978	7	3	35
1978	8	5	34
1978	9	4	30
1978	10	1	40
1979	6	19	35
1979	7	13	32
1979	8	4	36
1979	9	6	35
1979	10	3	32
1980	6	19	39
1980	7	10	39
1980	8	6	31
1980	9	1	38
1980	10	4	37
1981	6	27	76
1981	7	15	44
1981	8	4	40
1981	9	3	34
1981	10	7	39
1982	6	14	52
1982	7	16	58
1982	8	5	39
1982	9	5	39
1982	10	4	29

TABLE B-5

BASIC MILITARY COMPENSATION
(Nominal dollars)

RANK	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
306	16172	17003	17980	18810	19777	21395	22647	24178	27173	31378
307	16172	17003	17980	18810	19777	21395	22647	24178	27173	31378
308	16656	17503	18504	19385	20375	22026	23288	24873	27971	32313
309	16656	17503	18504	19385	20375	22026	23288	24873	27971	32313
310	17394	18267	19309	20273	21312	22957	24270	25941	29210	33745
411	18415	19329	20451	21490	22656	24378	25828	27608	31070	35933
412	19254	20229	21392	22477	23684	25507	27039	28920	32517	37637
413	19254	20229	21392	22477	23684	25507	27039	28920	32517	37637
414	19978	20991	22295	23320	24572	26492	28040	29995	33741	39097
415	19978	28991	22295	23320	24572	26492	28040	29995	33741	39097
516	22622	23789	25203	26498	27970	30204	32048	34247	38551	44858
517	22622	23789	25203	26498	27970	30204	32048	34247	38551	44858
518	23706	24969	26423	27779	29358	31703	33601	35898	40470	47042
519	23706	24969	26423	27779	29358	31703	33601	35898	40470	47042
520	24333	25606	27097	28512	30140	32498	34467	36800	41562	48224
521	24333	25606	27097	28512	30140	32498	34467	36800	41562	48224
522	25061	26380	27939	29419	31060	33475	35507	37947	42877	49643
623	28230	29768	31511	33182	35114	37928	40209	43198	48625	56330
624	28230	29768	31511	33182	35114	37928	40209	43198	48625	56330
625	28230	29768	31511	33182	35114	37928	40209	43198	48625	56330
626	30319	31962	33900	35640	37675	40681	43188	46313	52195	60330
627	30319	31962	33900	35640	37675	40681	43188	46313	52195	60330
628	30319	31962	33900	35640	37675	40681	43188	46313	52195	60330
629	30319	31962	33900	35640	37675	40681	43188	46313	52195	60330
630	30319	31962	33900	35640	37675	40681	43188	46313	52195	60330

TABLE B-6

CIVILIAN OPPORTUNITY DATA

	Unemployment[a] rate	Δ Pilots[b]	Average pilot[b] salary
1972			
1973	4.8	1,579	32,249
1974	5.5	– 1,730	36,369
1975	8.3	– 1,415	41,304
1976	7.6	1,027	44,099
1977	6.9	770	49,192
1978	6.0	985	52,618
1979	5.8	4,255	55,754
1980	7.0	– 639	65,485
1981	7.5	– 1,388	72,253
1982	9.5	– 1,906	76,780

a. Obtained from Employment and Earnings, Bureau of Labor Statistics.
b. Obtained from the Airline Pilots Association.

TABLE B-7

OFFICERS PROJECTED TO RECEIVE ACIP IN 1984

	Number of Officers	ACIP ($)
Years of aviation service		
2 years or less	1,117	1,500
Over 2 years	568	1,872
Over 3 years	448	2,256
Over 4 years	725	2,472
Over 6 years	1,147	4,800
Over 12 years[a]	1,091	4,800
Years of commissioned service		
Over 18 years	163	4,440
Over 20 years	122	4,080
Over 22 years	80	3,720
Over 24 years	26	3,360
Over 25 years	39	3,000

SOURCE: Headquarters, USMC

a. The data received from the Marine Corps only gave the number of officers in the 7-18 YOS category. The number in the 13-18 YOS group was estimated by the number of aviators with 13-18 YOS calculated from the DMDC data.